BAR CODED NAVIGATION SYSTEM

STATEMENT OF INVENTION

_____This application claims the benefit of provisional applications numbers 60/198,667, filed 4-20-00; number 60/222,592 filed 8-2-00; and number 60/245,587 filed 11-6-00.

This invention generally relates to vehicle navigation systems, and more particularly to such systems using bar coded signs for guiding a vehicle by incremental changes in direction.

BACKGROUND

Current navigation systems often seek to to guide vehicles along predetermined street routes that often result in delays due to traffic congestion, road repairs, and changes in the streets and roads.Many of such systems employ maps stored in the vehicle ststem memory that are used to provide such routing and therefore such systems periodically require updated maps to correct for

later changes in the streets or roads after the earlier maps were initially installed..

SUMMARY OF THE INVENTION

According to the invention there is provided a navigation system that progressively guides a vehicle toward a desired destination by incremental changes in heading direction . Thus whenever the vehicle is detoured away from a direct routing toward the destination , due to traffic congestion, road repairs , accidents, or for other reason, the system continually provides a new heading direction as needed from each different location to reach a selected destination.

In one preferred embodiment, the vehicle is initially guided to a zone or area containing the selected destination using bar coded street or road signs. After reaching that zone, the system then provides more detailed local information, using bar coded street signs, to guide the vehicle to the specific street or road within that zone, and ultimately guides the vehicle to a selected local address on the desired street or road. Local traffic restrictions, such as one way streets, or road repairs, are also provided by said instructions as well as supplemental local information, such as the availability of parking lots, gasoline, and service facilities to assist and minimize delays in navigating the vehicle. GPS and other wirelessly transmitted information may additionally or alternatively be used.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram illustrating one preferred navigation receiver,

FIG. 2 is a block diagram showing portions of a modified receiver,

FIG. 3 is an enlarged view of the receiver screen with guiding display,

FIG. 4 is a schematic illustration of a bar coded street or road sign with scanning light beam,

FIG. 5 is a schematic diagram illustrating the scanning of a bar coded street sign by a passing vehicle,

FIG. 6 is a plan view of the receiver screen showing street and road information being displayed,

FIG. 7 is a plan view of the receiver screen ,similar to FIG. 6, but showing additional local information in tabulated form,

FIG. 8 is a diagrammatic view showing bar coded building signs and the reading of such signs by passing vehicles, and

FIG. 9 illustrates the bar coded signs embedded in the roadway.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to the drawings there is shown in FIG. 1 a navigation receiver 10 according to the invention adapted to be provided within a vehicle for viewing by the vehicle operator. As shown, the receiver 10 has a visual display screen 11 and a keypad 12 with keys for enabling a vehicle operator to enter the

geographical coordinated of a selected destination.The receiver 10 receives the wirelessly transmitted GPS signals at 13 , and it displays the current location of the vehicle by a flashing light dot 14 on the screen 11. The different X-Y coordinate positions on the screen 11 represent and correspond to the geographical locations of the zone or area being traveled by the vehicle. Accordingly, as the vehicle proceeds from location-to- location within the zone, the flashing light dot 14 correspondingly changes its X-Y position on the receiver screen 11. The operator of the vehicle enters a selected X-Y destination location by its zone coordinates into the keypad 12, and the destination location is displayed on the screen 11 by a second flashing light dot 15, as shown in FIG. 1. Thus the displacement or distance between the two dots 14 and 15 corresponds to the distance between the present location of the vehicle and that of the desired destination, and the angle or heading displacement between the two dots 14 and 15 corresponds to the heading direction that should be followed by the vehicle to reach its selected destination. If the vehicle proceeds in the correct direction toward its destination, the dots 14 and 15 on the screen 11 are seen to converge toward each other.. On the other hand, where the vehicle detours away from such direct heading to destination, the vehicle location dot 14 diverges away from the fixed dot 15 on the screen 11. Thus by continually observing the display screen, the vehicle operator can determine whether the vehicle is correctly approaching toward the selected destination or proceeding away from the selected destination, and can therefore continuously or incrementally be informed of the correct heading to follow toward the selected destination.

The receiver screen 11 may display a map of the area, zone, or other region being traveled by the vehicle, with the X-Y coordinated of the dots 14 and 15 being located on such map at the correct street or road locations. However, according to the invention,such map display is unnecessary, since the operator of the vehicle need only note the relative positions of the two flashing

light dots 14 and 15 on the screen 11 and control the vehicle direction in order to bring about convergence of the two dots 14 and 15 on the screen toward each other.

As thus far described therefore, the vehicle operator need only note the distance and direction between the two light dots 14 and 15 on the screen as the vehicle proceeds from location to location, and control the vehicle heading so as to continually or incrementally head toward the selected end destination. Returning to FIG. 1, the vehicles compass heading can be shown by a heading display vector18 on the screen 11[provided by an electronic compass 17 energizing the receiver 10.)

In operation, as the vehicle proceeds from each location to the next, the light dot 14 shows such movement on the screen 11 to continually show the vehicle location on map displayed on the screen, or merely its X-Y coordinate location on the screen 11 without a map display. Whenever, the vehicle deviates from a correct heading direction, due to traffic congestion, road repairs, accidents, or any other reason, the dots 14 and 15 on the screen 11 diverge away from each other, and a new directional heading is required to be followed by the vehicle to reach its selected destination. Thus the vehicle can be incrementally guided from any location to another by controlling its heading direction alone to reach a desired destination.

AUDIBLE GUIDANCE

In the above described embodiment , the vehicle is guided by the vehicle operator continually, or incrementally , by changing its direction, as needed, by viewing the relative locations of the dots 14 and 15 on the receiver screen 11. However, such visually controlled guidance has the disadvantage of periodically diverting the vehicle operator's attention away from the street or road in un front of the vehicle in order to view the receiver screen 11. Such

diversion, can, of course, be minimized by employing a "heads-up" type of display from the receiver (not shown) where the receiver display is projected on the windshield or viewing window normally used by the vehicle operator to view the roadway and traffic immediately ahead of the vehicle. Alternatively, or additionally, such directional guidance may be provided by audible instructions from the receiver to the vehicle operator as shown in FIG. 2. Referring to FIG. 2, the receiver 11 may include a directional heading processor 19 that receives the changing vehicle location signal (from GPS 13 or bar coded sign reader 28 , as discussed below) and receives the destination signal from the keypad entry 12, to continually calculate the correct heading that should be followed by the vehicle to reach its selected destination. The processor 19 also continuously receives the compass heading signal 17 providing a reference heading of the vehicle. The processor 19 then compares the actual heading of the vehicle with the direction heading required to reach its selected destination to energize an audible generator 21, continually announcing instructions to turn left or right,as needed, to bring the vehicle to a correct heading. Where the deviation of the vehicle from the correct heading is substantial, the processor 19 is programmed to issue a repetitive series of left turn or right turn commands until the vehicle is restored to its correct heading direction.

The navigation receiver 10 may provide both a visual display of direction and distance as shown by FIG. 1 and described above, and an audible announcement as shown in FIG. 2 and described above. If desired, the heading processor 19 may also calculate the distance between the present location of the vehicle and the selected destination location, and this calculated distance may be displayed on the receiver screen 11 as a number 23, as shown, and may also be announced by audible generator 21 (FIG. 2) for each different location as the vehicle proceeds. Such displayed distance number 23 assists the vehicle operator in estimating the time of arrival at the selected destination.

Within zone navigation

In the above described embodiment the navigation system provides visual and/or audible guidance of the vehicle between the different geographic zones of the city or other community as shown by the cross hatched zones in FIG. 3 . Each zone may comprise an area of three or four square street blocks of the city , or an equivalent area elsewhere. After reaching the zone of the selected destination , the receiver may then be changed to provide a different display and/or audible announcement ,that conveys more specific

information to guide the vehicle directly to a selected street and ultimately to a specific address on such slected street.

To provide this more detailed guidance, each street or road intersection is provided with a coded sign 24, as shown in FIG. 4, that may be embedded in the roadway as shown in FIG. 9 being traveled by the vehicle, or may be provided as an upright sign 24 located near the shoulder of the road or otherwise near the roadway being traveled by the vehicle. Each such sign 24 contains a bar code 25 that identifies the zone of the city and the street or roadway being traveled by the vehicle together with additional information pertaining to the location of that sign 24, such as nearby intersecting streets and roads. According to the invention, the vehicle 30 (FIG. 5) is provided with a wireless reader 28 , as shown in FIG.2,and FIG.5, to read each of these coded signs 24 as it passes the location of each such sign 24. As shownin FIG. 4, the wireless reader generates a short range wireless beam 27 that scans each sign 24 as the vehicle passes by that sign, thereby to reflect the bar coded information back to the navigation receiver 10 (FIG. 2) and its heading processor 19 (FIG. 2). Thus as the vehicle 30 proceeds from street to street within each zone , its wireless reader 28 successively scans and reads each

of the fixed bar coded street signs 24 along its route to continually receive detailed information concerning each different location of the vehicle.

In one embodiment,illustrated by FIG. 6, the detailed information on each sign 24 preferably includes the names of three or more streets or road intersections immediately ahead of each sign 24 ,as well as those of a series of streets on each side of the vehicle, and those behind the vehicle 30. All of such street information being read from each sign 24 is displayed on the receiver screen 11 as shown in FIG. 6. Still further, the signs 24 may also contain or reference, information about each such street or roadway, as shown by the display illustrated in FIG. 7, such as whether each such street 32 has parking available 36, or whether each such street 33 has traffic flow restrictions, such as a one way passage restriction 37 and the direction thereof. Still further the signs 24 may also contain information such as the availability of gasoline 39 on any street, or other service facilty, and also the range of street numbers 40 on each street, as shown, to better enable guidance of the vehicle 30 directly to a desired street address.

Thus in summary, each of the fixed coded street or roadway signs 24 , containing or referencing the detailed street and traffic control information , is

read by passing vehicles and the information from each sign is displayed on the vehicle navigation screen 11 . This assists the vehicle operator in navigating directly to a desired street despite traffic restrictions, such as one way passage, or roadway repairs or the like. The signs also notify the operator of the vehicle of the availability of parking facilities, gasoline or service facilites on the different streets whereby the vehicle is not delayed in looking for such needs. It will be appreciated that such detailed guidance information not only assists the vehicle operators in promptly reaching a desired destinations as well as in parking or refueling, as may be necessary, but also assists other vehicles by reducing traffic delays. For example, whenever a vehicle is required to stop or delay seeking a parking location or fuel or other service, any such delay also progressively delays other vehicles that may be traveling behind such vehicle. Accordingly the more rapidly that each vehicle can proceed directly to its desired destination reduces traffic delays and congestion for all other travelers proceeding along that roadway.

As discussed above, the coded signs 24 also contain ,or reference, the range of street addresses 40 (FIG.7) on each street or roadway, and therefore directly guide the vehicle 30 to a desired address.

However, during conditions of poor visibility, the address numbers on different buildings may not be readily visible to the vehicle operator resulting in delays in finding a correct building or street location. To avoid this difficulty, the buildings 41, 42 on each street may also be provided with a coded sign 43,44 to identify such building , as shown in FIG. 8. Referring to FIG. 8, each building 41 and 42 may have its own bar coded sign 43 and 44 , respectively, that identifies ,or references, that building address as well as providing additional information about that building. Passing vehicles 30 can scan and read such building signs 43, 44 in the same manner as reading the street signs 24, discussed above, and the identity of such buildings can be displayed on the navigation receiver screen 11 to assist the vehicle operator in finding the desired street address and/or building despite poor visability conditions.

As thus far described the vehicle can be promptly and easily navigated to a selected location in a two part process. Initially the vehicle can be incrementally guided from any zone to another zone within a city or community by merely following the directions shown between two flashing light dots on the vehicle screen 11 and/or by following the corresponding audible instructions from the vehicle audible generator 21. Upon reaching the zone of the

selected destination, the vehicle operator may then switch the receiver ,using the keypad 12 (FIG1) to a different display on the receiver screen 11 that responds to the system reading each of the coded street signs 24 to continually show the names of the streets around the vehicle and information pertaining to each of such streets. Upon reaching a desired street the vehicle operator can locate a desired address on that street by observing a different display upon the screen 11 that is obtained by the reader 28 scanning and reading the codes from the coded signs 43,44 provided on the buildings 41,42 (FIG. 8).

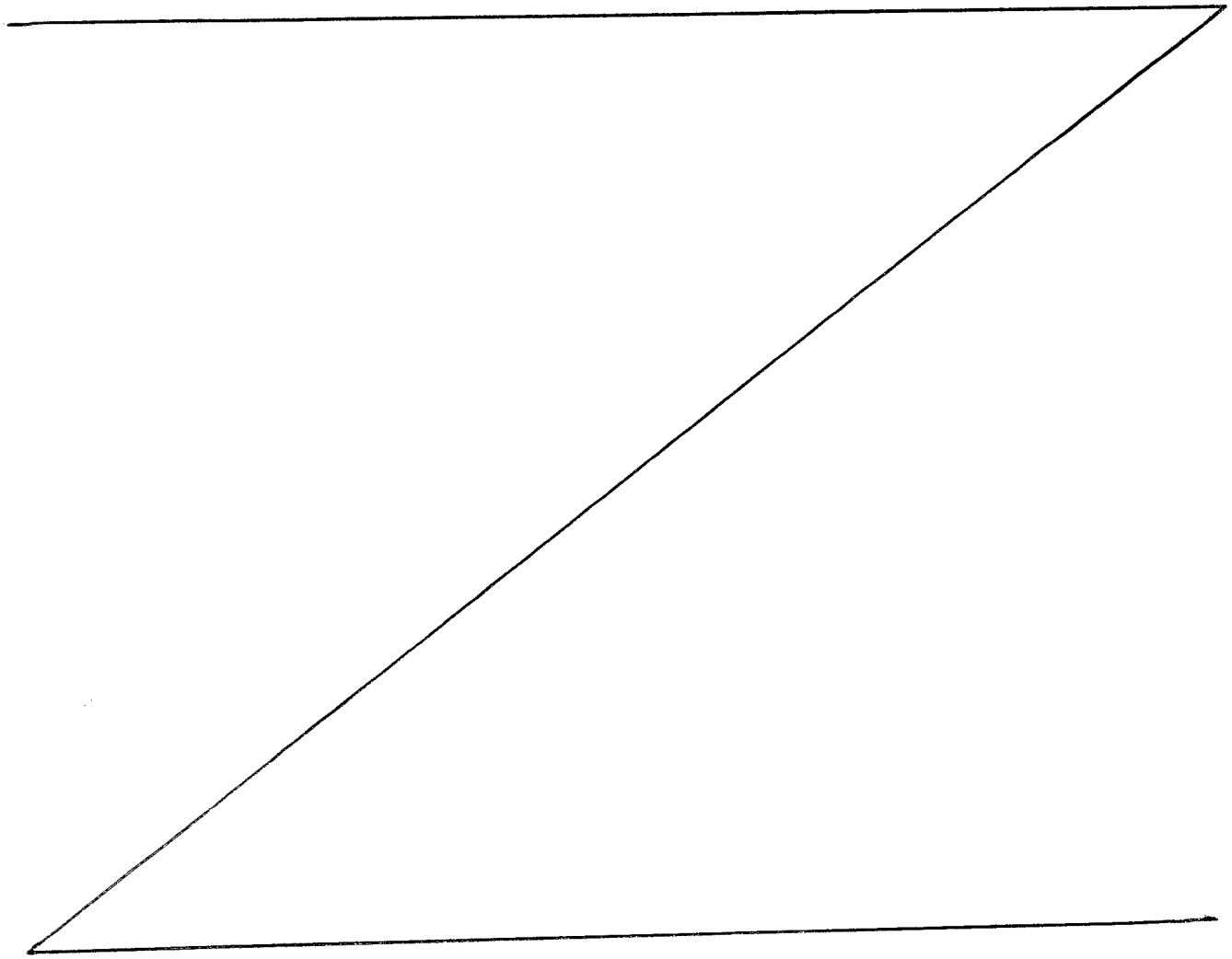
It will be recalled from the above description that the guidance of the vehicle from zone to zone may be performed using the GPS satellite transmissions that are received by the navigation receiver 10 (FIG. 1) to continually provide the changing location of the vehicle as it proceeds. However, the GPS signals provide only location information and not the additional guidance information about the streets, roads, traffic conditions and the like as discussed above (FIGS. 6 and 7). Since the coded street-road signs 24 also contain ,or reference, the location information, as well as all of the additional information discussed above, the coded street signs 24 may be used alone without the GPS signals for navigating from zone to zone as well as in

navigation to specific locations within each zone. Of course, in outlying areas, or in small cities, or villages where the coded street signs 24 may not available, the GPS transmissions can be employed for zone to zone navigation purposes, and the vehicle operators can rely upon observing conventional road and street signs to locate streets, and addresses on said streets as well as to locate gas stations and the like. Of course, where the coded street signs are available,the system can employ both the GPS transmissions and the reading of the coded street signs 24 for navigating purposes.

AUDIBLE INFORMATION SUPPLEMENTS

Audible guidance of a vehicle provides the advantage of permitting an operator to give full time and attention to roadway conditions without diverting the operator's attention to viewing a vehicle installeddisplay screen from time-to-time. Accordingly, as each of the coded street signs 24 is scanned and read to the receiver 10, or as each of the building signs 43,44 are scanned and read by the vehicle reader 28 , the receiver audible generator 21 (FIG. 2) may announce the names of the streets or building addresses, or of the roads or streets around the vehicle as well as the other information as discussed above . Such information can also be

concurrently displayed on the screen 11 as shown in FIGS. 6 and 7. Such audible announcements alert the vehicle operator to the approaching streets, or provide other information, that may have been overlooked by failing to note it on the receiver screen 11. Similarly other information being read from the coded street-road signs 24 or building signs 43, 44 may also be audibly announced for the same reasons, to not only inform the operator of such information but also to alert the operator and insure that such information has not been overlooked.



CODED STREET SIGNS AND READER

As discussed above the bar coded signs 24 identify the zone locations of each sign and contain, or reference, other information to be displayed, and/or audibly announced, to the operator of the vehicle. These signs are adapted to be located along the streets and roadways , or embedded in the the roadways, near the passing vehicles to permit reading of the signs 24 by code readers 28 carried by the vehicles.The signs may alternatively be located above the roadways, supported by cables or structure that support stop lights or conventional signs.For more positive reading of the coded signs 24, the codes may be formed of retro-reflective materials for better reflection. Bar code readers 28 for use in the present invention are available as laser scanners that can read signs of reasonable size and dimensions at distances from such signs up to 33 feet away. Among other models the WORTH DATA LZ100 and LZ200 models are considered to be satisfactory for such uses.

As is known, the bar codes being illuminated by the laser beams of the readers 28 are reflected back to the navigation receiver 10 to read such codes. These codes also contain, or reference ,the the street names, traffic controls, and other information, as discussed above, that is relevant to the location of each sign 24. Where the information to be conveyed exceeds the capacity of the signs 24, such additional information can be stored in memory in the navigation receiver 10 at addresses corresponding to the codes on the signs 24, As each code is read, such additional information (FIGS 6 and 7) can be downloaded from the receiver memory to be displayed on the screen. Detailed zone maps stored in the receiver memory (not shown) may alternatively be selected for display upon the code readers reading the coded signs.

DISPLAYS IN DIFFERENT SCALE

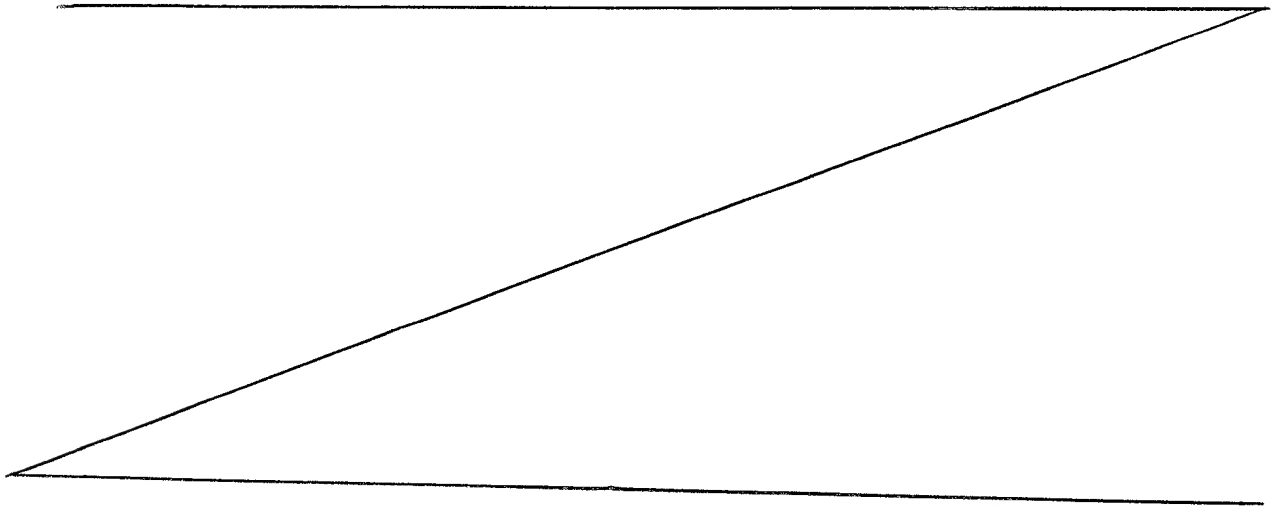
Since the areas covered by different cities or towns vary significantly in size from one another, the present invention provides for differently scaled displays on the receiver screen 11 . The differently scaled displays may be selected by the vehicle operator using the receiver keypad 12, and/or adjustment 50 (FIG. 2) to cover an entire region or a portion of such region.

Thus where the vehicle is located at a great distance from a selected destination, the scale may be correspondingly selected to view the flashing light dots 14 and 15. Whereas when the vehicle proceeds near the desired destination zone the scale can be varied to more precisely navigate toward the the destination, to better show the correct heading.Such reduction or enlargement of the scale of distances may also be performaed automatically using the heading processor (FIG. 2) to calculate the distances between present vehicle location and the location of the destination.

Where maps of the city or portions thereof are being used for display, yhe map areas being selected may also be varied manually or automatically to show details of the region in greater or lesser detail.

TRAFFIC RESTRICTIONS

As discussed above the coded signs 24 may also contain, or reference, various traffic control information, such as one way streets, dead end streets, street numbers , names,and others.Still further such signs 24 may also contain , or reference, speed limits, stop lights or stop signs, curving roads, and other information that is now made available only by visually readable signs. As such coded signs are remotely read by the vehicle readers, such information is displayed on the interior navigation screen 11 and can also , or alternatively be audibly announced by the receiver audible announcer 21. Accordingly during periods of poor visibility, the vehicle operators can be provided with such information on the illuminated navigation receiver screen 11 when such information is not otherwise visible. Such internal communication of such information also provides a reminder to the vehicle operator where the corresponding externally visible signs have been overlooked.



OTHER DIGITALLY CODED SIGNS

According to the invention, digitally coded street-road signs can also be employed for purposes other than vehicle navigation to assist vehicle operators in complying with traffic laws, to notify operators of road conditions , and to otherwise provide the same functions as are presently provided by conventional road signs now commonly provided on many streets and roads . For example, conventional street-road signs that visually notify operators of speed limits, or of stop lights, or stop signs, can be modified or replaced by having such visually readable signs also bear the same information in digitally coded form, thereby to enable such signs to be automatically read by the vehicle scanners 28 (FIGS. 1 and 2) of passing vehicles. Thus as such vehicles pass each such sign, the coded information is read by the vehicle scanner 28, and its content is displayed on the receiver screen 11 and/or announced by the vehicle audible announcer 21.

Since the content of conventional street-road signs of this type are uniform throughout the United States, the contents of all of such different conventional signs may be prestored in a memory 51 of the vehicle receiver 10 (FIG. 1) with each different message being stored at a unique different address of the memory 51. Each different street-road sign may then contain ,in coded form, the address of the message that is appropriate at the location of that sign, whereby upon reading the code of each sign , the corresponding message is downloaded from the memory 51 to be displayed and/or announced from the receiver 10.

The ROM memory 51 may contain maps, places of interest, and additional information of assistance to the vehicle operator, all of which can be accessed upon the vehicle reader 28 reading the digital code or codes provided on the street-road signs. Thus at each different location along the streets or roadways, the digital code or codes on the sign at that location accesses the messages and information stored in the receiver ROM memory and related to that location. As is illustrated in FIG. 1, the ROM memory 51 may be in the form of a removable disc or other removable memory , and one or more of such memories may be provided for each vehicle depending upon the extent of information desired to be made available to the vehicle operator. Such digitally coded street-road signs may be used alone for navigation and other purposes as described above, or their use may be supplemented by the use of the received G.P.S. signals 13 as shown in FIGS. 1 and 2.